EOEA #10270

Executive Summary

NorthSouthRailLink
PROJECT

Major Investment Study

Draft Environmental Impact Report

June 2003

United States Department of Transportation Federal Transit Administration

Massachusetts Bay Transportation Authority

In partnership with:

National Railroad Passenger Corporation

Massachusetts Executive Office of Transportation and Construction

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Massachusetts Bay Transportation Authority (MBTA)
U.S. Department of Transportation, Federal Transit Administration (FTA)

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National Railroad Passenger Corporation (Amtrak)
Massachusetts Executive Office of Transportation and Construction (EOTC)

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Introduction

The North-South Rail Link (NSRL) is a proposed connection between North and South Stations in Boston, Massachusetts. This link would close the one mile gap that exists in intercity passenger rail service on the Northeast Corridor (NEC) between southern and northern New England, and connect the separate north and south side commuter rail systems.

This Major Investment Study/Draft Environmental Impact Report (MIS/DEIR) discusses the project purpose and need, describes the alternatives considered to close the gap, and presents an evaluation of the transportation, environmental, cost and financial considerations of each of the alternatives. Developed through a public participation process, it is a tool for Federal and state governments, public agencies, and the general public to make an informed decision on the proposed connection between North and South Stations. The results of the MIS/DEIR are summarized in this Executive Summary.

Historical Context

The one-mile separation of Boston's north side and south side rail systems, with their respective passenger terminals, is a result of the historical development of railroads in Massachusetts, along with the constraints of local topography and land use. The earliest considerations of a rail link were documented in the Massachusetts Commission on Metropolitan Improvements' 1909 report, *Public Improvements for Metropolitan District*. In 1972, a master plan for depressing the Central Artery, proposed the construction of a two-track tunnel at the same elevation as the highway tunnel, with portals located in the rail yards of North and South Stations.

In 1993, the Central Artery Rail Link (CARL) task force concluded that a rail link tunnel could be built under the new depressed Central Artery (CA/T). Studies of a rail connection were also conducted by the Boston Society of Civil Engineers, the Massachusetts Executive Office of Transportation and Construction, and the Federal Transit Administration (FTA).[1]

In late 1993, the U.S. Congress directed the National Rail Passenger Corporation (Amtrak) to undertake a study of a rail link tunnel connecting

[1] Boston Society of Civil Engineers (BSCE), 1993 *North-South Rail Link Study Committee*. Central Artery Rail Link Task Force (CARL), Massachusetts Executive Office of Transportation and Construction. May 1993. *Building for an Intermodal Future: The North-South Rail Link*. Boston, MA; Massachusetts Executive Office of Transportation and Construction. October 1994. *Accessing the Future: The Intermodal Transportation Plan for the Commonwealth of Massachusetts (Review Draft)*. Boston, MA; Federal Transit Administration, U.S. Department of Transportation. August 1995. *Final Report: Feasibility Study of a Proposed Rail Link between North Station and South Station in Boston, MA.*

North and South Stations within the Central Artery (Interstate 93) highway alignment in Boston. Amtrak entered into an agreement with the Executive Office of Transportation and Construction (EOTC) whereby the MBTA would manage the NSRL Study in collaboration with the Massachusetts Highway Department (MassHighway), EOTC, and Amtrak. The Federal Transit Administration (FTA) is the lead Federal agency for the study.

Three immediate objectives were determined for the study:

- Identify the operational requirements and the service design for a rail link that could serve both intercity and commuter rail transportation needs.
- Preserve the option of constructing a rail link within the Central Artery highway alignment at a later date.
- Identify potential environmental impacts for the rail link alternatives.

Purpose and Need

The emphasis in public transportation policy has shifted over the past decade from building new highways to a policy of making more efficient use of the existing transportation infrastructure and on providing a balanced transportation system. The key federal legislation that has led to the shift was the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and its 1998 update, the Transportation Equity Act for the 21st Century (TEA-21). This landmark legislation has promoted the development of economically efficient and environmentally sound intermodal surface transportation systems. The purpose and need for the NSRL was developed within the context of this national transportation policy.

Northeast Corridor (NEC) Transportation Needs

Interstate Highways. Interstate 95 provides the primary connection between communities along the eastern seaboard from Maine to Virginia and defines the area known as the Northeast Corridor (NEC). Roadway congestion is becoming an increasing problem within the corridor and there is little opportunity to further expand highway capacity.

Intercity Passenger Rail Service. Passenger rail service provides an alternate mode choice for travel in the NEC. Amtrak's recent electrification and high speed rail improvements on the NEC make train travel a more attractive option by reducing travel time between Boston and New York to approximately three and one-half hours with service terminating at South Station. Access to this transportation mode, however, is not convenient for people traveling to or from the northern portion of the NEC in New Hampshire, Maine, and Massachusetts communities north of Boston.

Intercity service from Boston to Portland, Maine, referred to as the "Downeaster", was inaugurated in December 2001. This intercity rail service operating on the northern portion of the NEC terminates at North Station, and passengers wishing to travel further south on the NEC have to change transit modes and travel to South Station to continue their journey. Figure ES-1 illustrates the gap in intercity rail service.

Intercity Air Travel. Air travel also plays a role in transportation mode choice in the NEC. Logan Airport is one of the busiest passenger airports in the country, handling approximately 27.4 million passengers in 2001.[2] The projected yearly passenger level is expected to increase to up to 37.5 million passengers by 2015. A key route is Boston to New York which is the fourth highest city pair market for domestic air trips in the nation[3]. Providing a convenient and reliable connection to NEC rail service from downtown, as well as from the north of Boston, may relieve Logan Airport congestion by shifting shorter shuttle flights from the airlines to intercity rail.

Regional Transportation Needs

The City of Boston is an economic center for both the metropolitan region as well as the larger New England area. The Boston Metropolitan Area accounts for more than two-thirds of the Commonwealth of Massachusetts' employment base, and almost half of the state's population.[4] An efficient and accessible transportation network is a key component to the economic vitality of the region. The metropolitan area is served by a transportation network that includes highways, commuter and intercity rail, buses, rapid transit, commuter boats, and airports.

Regional Highway System. The regional highway system is becoming more congested each year. Daily vehicle miles traveled (VMT) is projected to increase by 139 percent between 1995 and 2025, to a total of 149.1 million miles per day.[5] [6] This growth in vehicle travel has lead to increased congestion on the regional highway system within the Interstate 495 region. The highway system in the Boston metropolitan region is a mature system, and it is unlikely that much additional highway capacity will be built.

Commuter Rail Service. Commuter rail service is operated by the Massachusetts Bay Transportation Authority (MBTA) as shown in Figure ES-2. Two distinct systems terminate at the edge of the central business

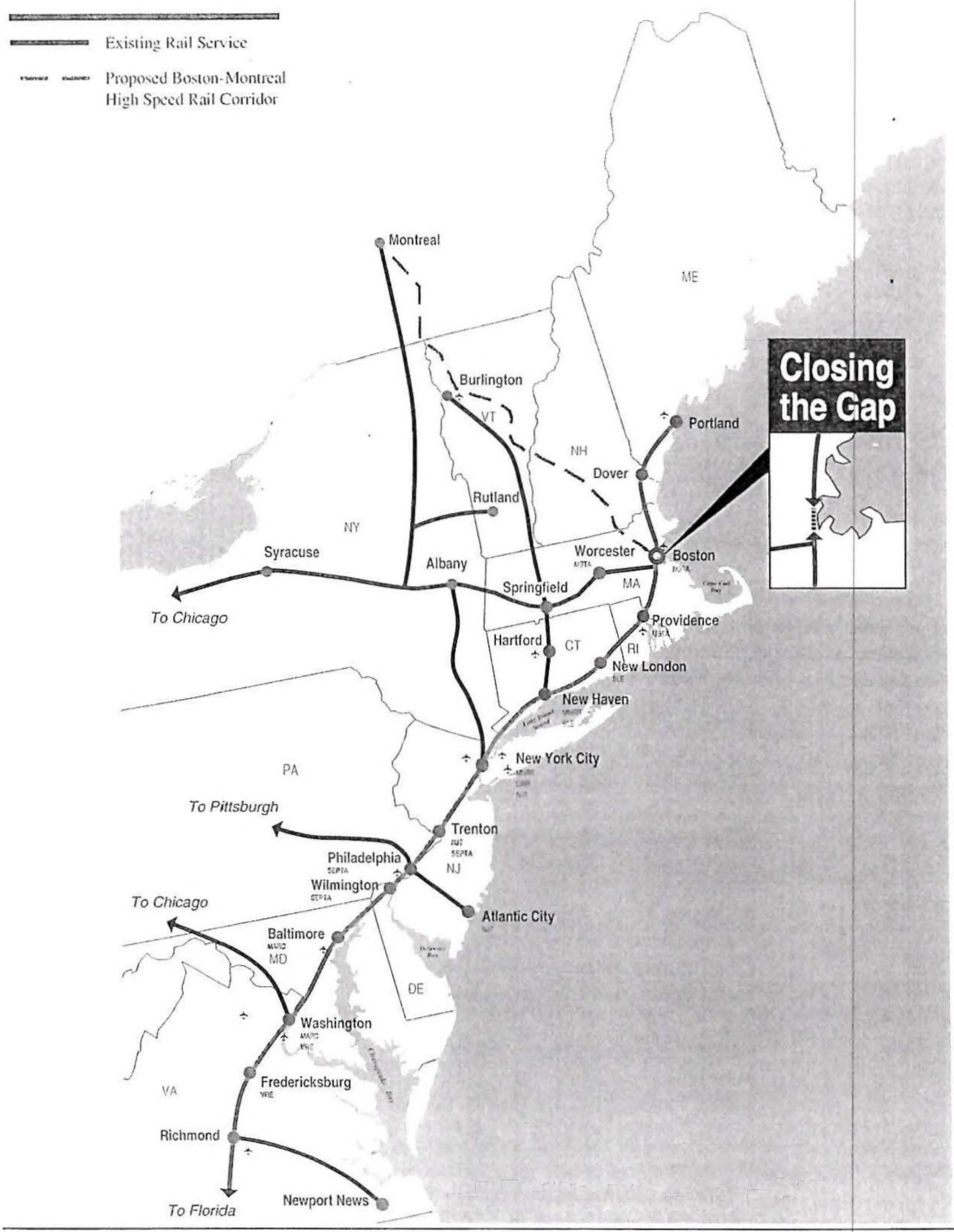
[2] While the volume of air passengers declined in 2001 as a result of a slowing economy and the events of September 11, 2001, air passenger demand is expected to increase in the future.

[3] "Top 25 Domestic City-Pair Markets," *Aviation Daily*, p. 381, March 7, 1996.

[4] Boston Metropolitan Planning Organization Regional Transportation Plan Summary in *Accessing the Future - The Intermodal Transportation Plan for the Commonwealth of Massachusetts*, 1995.

[5] *Existing Needs Analysis for the Boston MPO Transportation Plan* (Circulation Draft), Boston Metropolitan Planning Organization, February 1996.

[6] Memo from Vijay Mahal, CTPS to Joe Cosgrove, MBTA regarding Ridership Results of the Rail Link Alternatives, December 24, 2002.



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Intercity Rail Service Figure ES-1

district in Boston, specifically at North Station and South Station, which are separated by a distance of about one-mile.

Daily ridership has grown significantly on the MBTA commuter rail system from a total of 75,000 in 1990 to approximately 126,800 in 2000, an increase of approximately 69 percent. By 2025, ridership demand is projected to grow to 244,600 daily boardings.

As ridership continues to grow, peak period terminal operations will become more congested. South Station would likely exceed the effective capacity during the peak period under the 2025 No-Build conditions, with North Station approaching a similar condition.

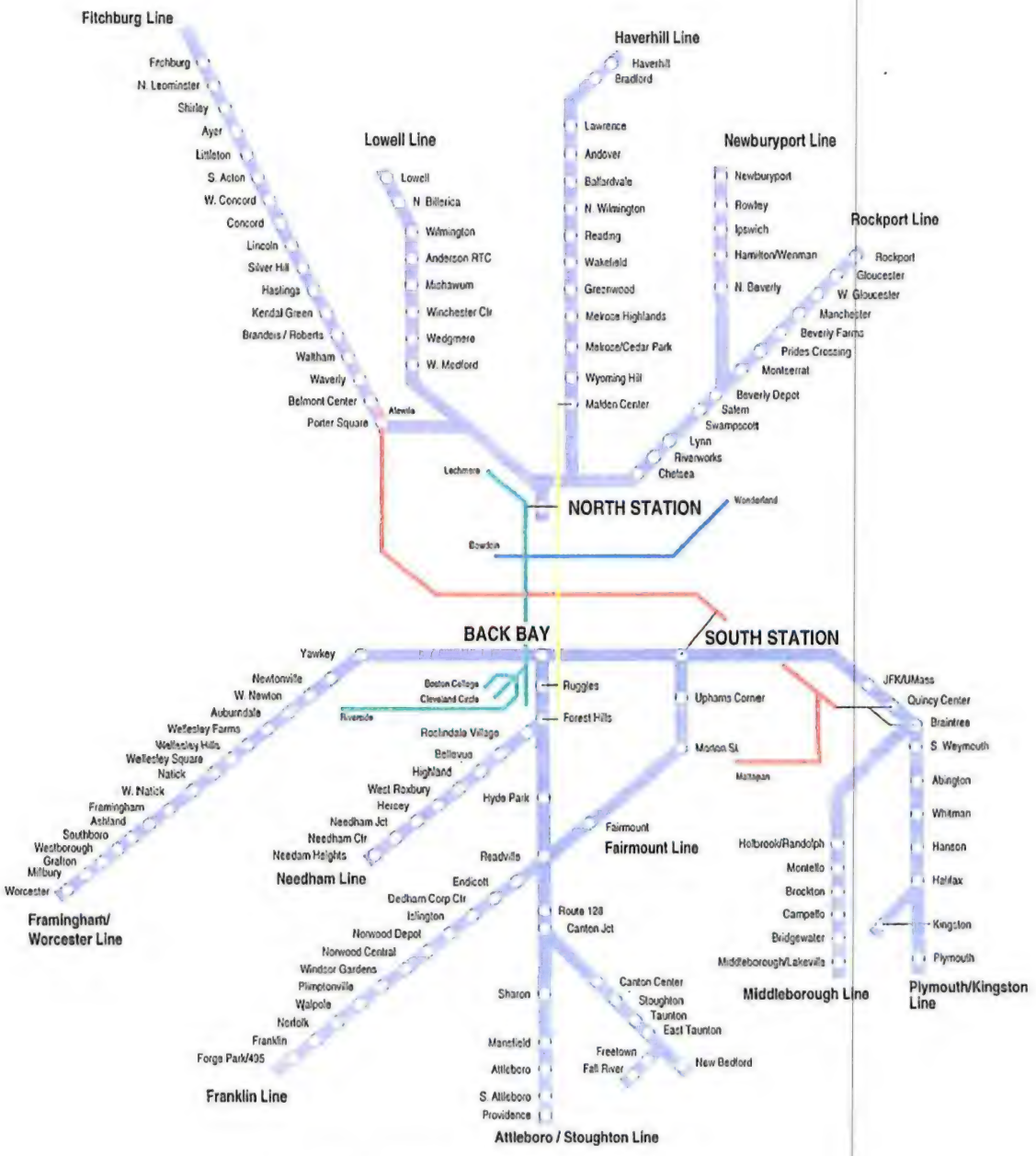
Rapid Transit Services. Many commuter rail riders transfer to the MBTA's rapid transit system at Back Bay, South Station and North Station to reach their final destination in downtown Boston. These transfers generally occur during the peak weekday commuting periods and add to the burden that the transit system must carry during these periods. As ridership continues to grow, the carrying capacity of the four rapid transit lines within the downtown Boston portion of the system is projected to approach maximum load conditions.

Logan Airport Ground Transportation Congestion. Improving regional rail and transit access to Logan Airport, particularly from the north, will help to reduce ground transportation congestion at the airport.

Project Goals and Objectives

The study goals and objectives have been developed to address the project purpose and need and are consistent with the goals and policies of those contained within the *1997 Transportation Plan for the Boston Region. The Boston MPO Transportation Plan 2000-2025* presents a revised version of these goals and policies, but their overall intent is similar to those contained within the 1997 plan. The following goals and objectives were used in the development, screening, and evaluation of the alternatives considered in this MIS/DEIR:

- Goal 1: Preserve and Upgrade Existing Transportation Systems and Congestion on Existing Services and Facilities.
- Goal 2: Provide Increased Opportunities for Multi-modal/Intermodal Connections.
- Goal 3: Optimize Use of the Existing and Programmed Transportation Infrastructure and Investments.
- Goal 4: Optimize Environmental and Economic Benefits.



Source: Base Plan from Central Transportation Planning Staff.

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MBTA Commuter Rail System Figure ES-2

Description of the Project Alternatives

The study area used for the analysis of alternatives encompasses the Boston metropolitan region, an area roughly defined by the boundaries of Interstate 495 (I-495). Intercity rail service along the NEC between New York City and Maine was also evaluated. The sections below describe the alternatives considered for the North-South Rail Link MIS/DEIR.

No-Build Alternative

The 2025 No-Build Alternative provides the basis against which the impacts of the other alternatives are assessed. The No-Build Alternative includes the existing transportation system as well as all of the projects currently in *the Boston MPO Transportation Plan 2000-2025.*

Transportation System Management (TSM) Alternatives

TSM alternatives typically include enhancements to existing transit services, which require minimal investment in new or upgraded infrastructure. The two TSM options evaluated for the NSRL include:

A Dedicated Shuttle Bus Service between North and South Stations. Two routes were considered: one, a downtown shuttle through Post Office Square along Congress Street; the other would use the post-CA/T reconstructed surface artery network. Shuttle bus service on either route would operate on five-minute headways and require six new articulated buses to provide the service. This TSM Alternative option would not require any construction within the project corridor.

Increased Orange Line Service. The MBTA's Orange Line rapid transit service connects with the south side commuter rail system at Back Bay Station, and with the north side commuter rail system at North Station. This TSM alternative would decrease peak period headways between Back Bay and North Station from 5 minutes to 2.5 minutes (24 trains per hour in each direction) and would require the addition of 43 new vehicles.

Increasing the service frequency would require the addition of two passing tracks to allow the trains to reverse direction after Back Bay and North Station. These passing tracks could not be built at Back Bay or North Station due to physical constraints at these locations. The closest available location for the passing track on the north side is between Community College and Wellington Stations, where there is an unused Orange Line track known as the "Test Track" that can be used as a passing track. A new track however would need to be constructed on the south side for this TSM Alternative option. The closest location to Back Bay for this track would be between Ruggles and Roxbury Crossing Stations.

Build Alternative

The Build Alternative is a rail tunnel connecting North and South Stations that allows for the conversion of the two existing stub-end rail systems into a single rail system with service through downtown Boston. It was assumed for the purposes of the MIS/DEIR evaluation that construction of the Build Alternative would commence after the CA/T construction is completed and the Surface Artery parcels are in various stages of development.

The Build Alternative contains a number of design options based on the combination of the following design components:

- the number of tracks in the tunnel (two or four),
- the location of the southern portals (Back Bay or South Bay) for a two-track alternative,
- the number of stations provided (two or three), and
- the alignment for the southern section of the tunnel (CA/T Alignment or Dorchester Avenue Alignment).

The following four options for the Build Alternative were evaluated for the MIS/DEIR. Each option was analyzed in terms of operations, ridership, costs, and environmental impacts.

- Two-Track/Two-Station Option
- Two-Track/Three-Station Option
- Four-Track/Two-Station Option
- Four-Track/Three-Station Option

Screening of Alignment Corridors

Three potential alignment corridors were initially considered for the Build Alternative: the CA/T corridor, the Congress Street corridor, and the Logan Airport corridor. It was determined that the Logan Airport corridor should not be considered for further analysis since it posed many serious operational, environmental, and construction cost issues while offering fewer benefits than the other corridors. The Congress Street alignment was found to be constrained due to the narrow corridor which presented the potential for greater construction and operational impacts. The CA/T corridor was therefore recommended as the preferred corridor for further analysis of the Build Alternative. The Dorchester Avenue alignment option was developed subsequent to the initial screening process.

Build Alternative Tunnel Alignment, Track and Portal Options

Tunnel Alignment. The schematic tunnel design developed by the NSRL study recommends a deep bore tunnel to be constructed by a Tunnel Boring Machine (TBM). A deep bore tunnel allows for the physical separation of the rail link tunnel from the CA/T and allows the construction of each project to proceed independently, thereby preserving the option of constructing the rail link within the CA/T corridor.

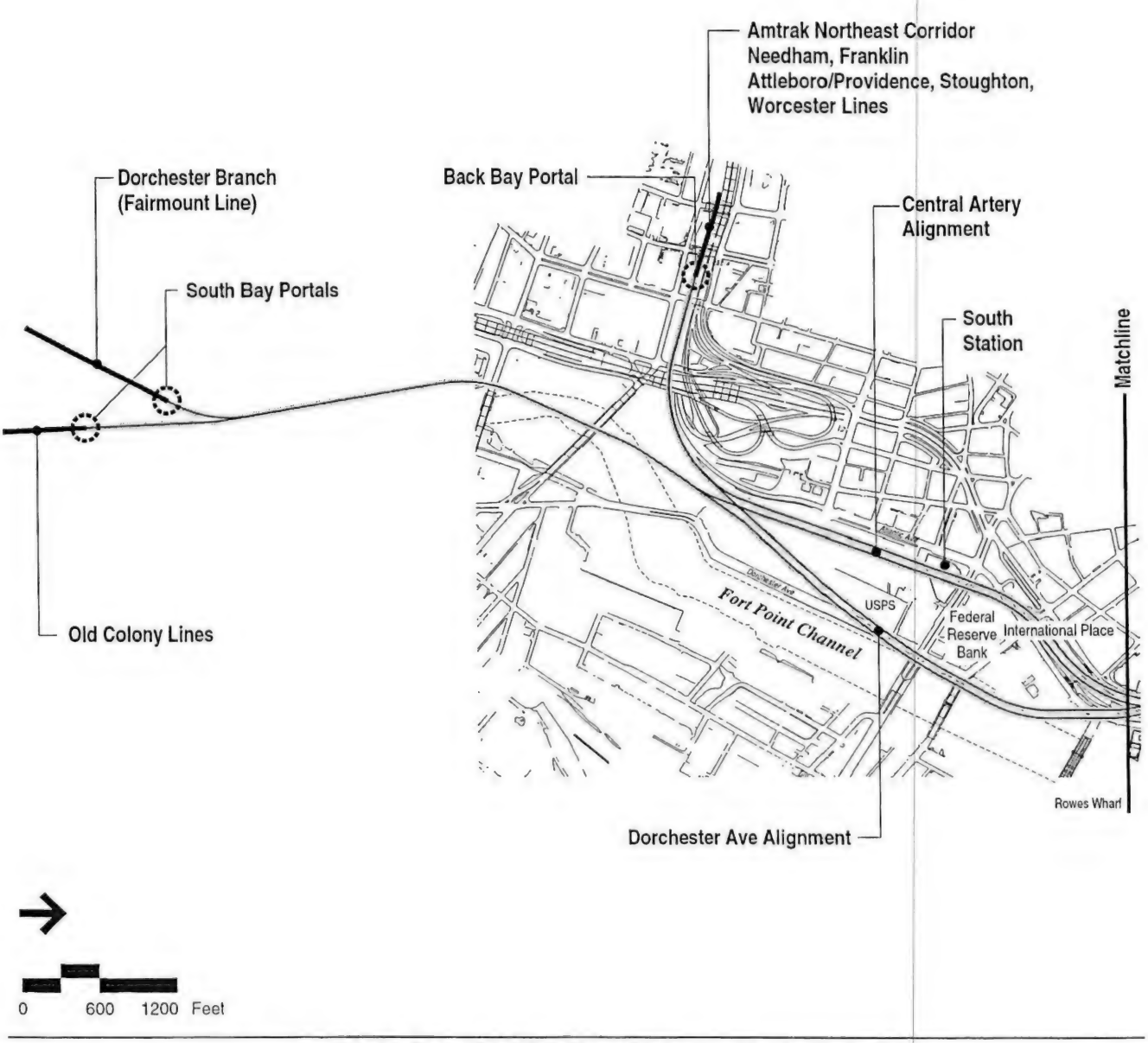
The majority of the alignment for the proposed three-mile rail tunnel between South Station and North Station is in Boston and would be within the CA/T project corridor, as shown in Figure ES-3. South of South Station the alignment would extend west to a portal at Back Bay and south to a portal in the South Bay railroad maintenance facility and yard. From North Station, the alignment would extend north into Cambridge and Somerville to two portals in the area of the Boston Engine Terminal (BET). Two options for the southern portion of the tunnel alignment, known as the CA/T Alignment and the Dorchester Avenue alignment, were evaluated.

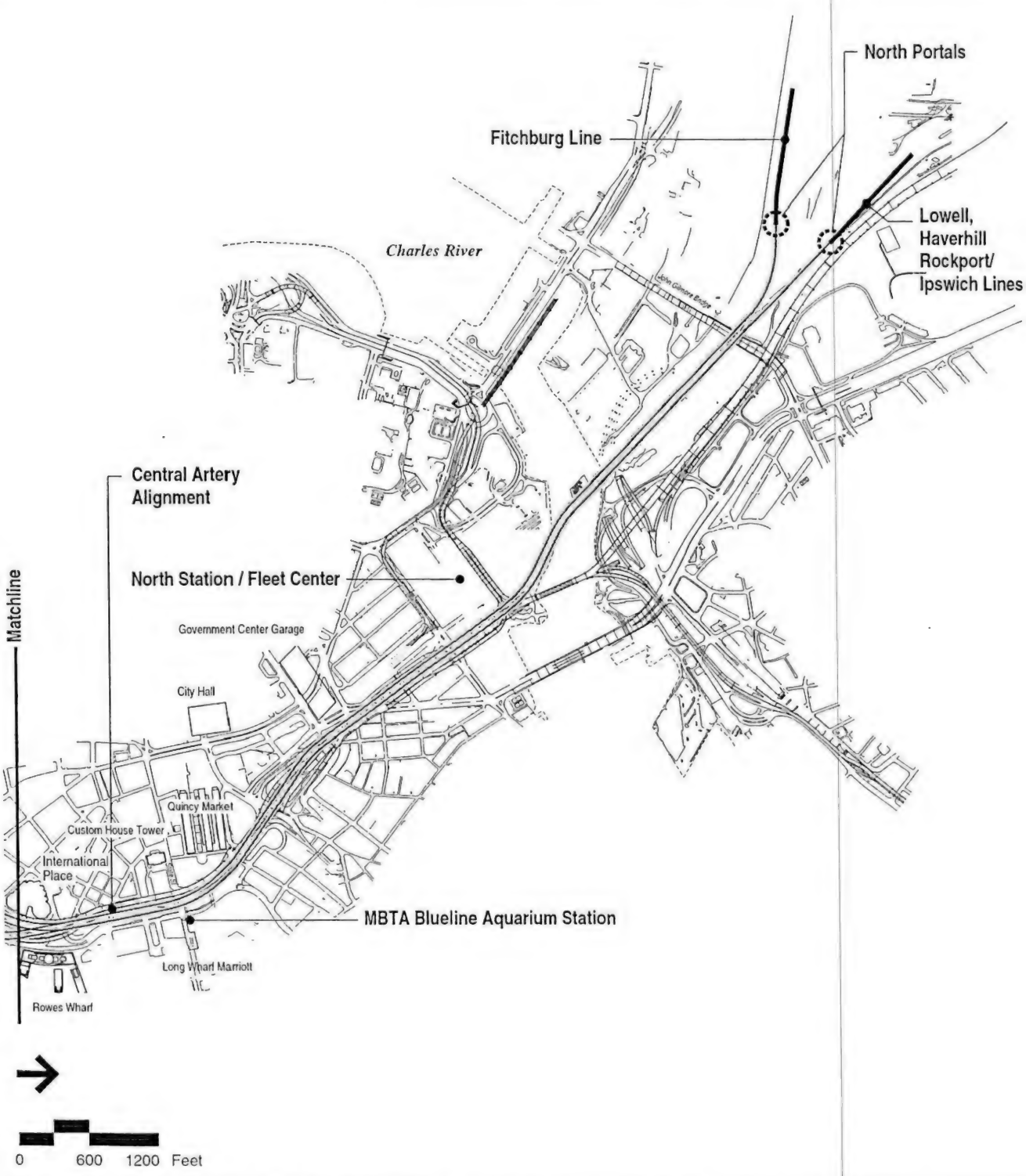
The CA/T alignment follows the alignment originally developed by the CARL Task Force, which would place the rail link South Station under the existing South Station tracks and headhouse. The Dorchester Avenue alignment was developed during the schematic design phase to provide a station option that avoids the pile foundation (caissons) installed under the existing South Station tracks to support the South Station Transportation Center (SSTC) building as well as future air rights development. It positions the proposed rail link South Station east of the existing South Station, along the western edge of Fort Point Channel at the northern end of the US Postal Service facility.

Only one alignment is considered from approximately Rowes Wharf north. It would be located in the Central Artery corridor as defined by its exterior soldier pile walls.

The Four-Track Option proposes twin 41-foot diameter two-track tunnels, except in the area of the new CA/T I-93/I-90 South Bay interchange where space is very constrained. In that area, two smaller single-track tunnels are proposed. These tunnels would descend at grades approaching three percent and pass below the I-90 tunnels with very little clearance to spare.

The Two-Track Option consists of one tunnel extending from either Back Bay to the North Portals or from South Bay to the North Portals. Under the Two-Track Option, all of the north side service would run through the tunnel, but only half of the south side service would. Therefore, both of the north portals, one providing access to the Fitchburg Line and the other to the Lowell, Haverhill and Rockport/Ipswich Lines, were assumed to be constructed under the Two-Track Option.


Amtrak Northeast Corridor
Needham, Franklin
Attleboro/Providence, Stoughton,
Worcester Lines
Dorchester Branch
(Fairmount Line)
Back Bay Portal
Central Artery
Alignment
South Bay Portals
South
Station
Matchline
Old Colony Lines
Fort Point Channel
USPS
Federal
Reserve
Bank
International Place
Rowes Wharf
Dorchester Ave Alignment
0
600
1200 Feet


North Portals
Fitchburg Line
Lowell,
Haverhill
Rockport/
Ipswich Lines
Charles River
Central Artery
Alignment
North Station / Fleet Center
Matchline
Government Center Garage
City Hall
Quincy Market
Custom House Tower
International
Place
MBTA Blueline Aquarium Station
Long Wharf Marriott
Rowes Wharf
0
600
1200
Feet

Stations

Two-and Three-Station Options were evaluated for the Build Alternative. The Two-Station Option includes new underground North and South Stations. The Three-Station Option adds a Central Station in the vicinity of State Street, which would connect to the MBTA Blue Line at Aquarium Station.

South Station. The proposed underground rail link South Station would generally be located in the area of the existing South Station. The existing station headhouse would continue to serve as the main entrance to South Station, and escalators and elevators would bring passengers to the underground rail link platforms located approximately 100 feet below the surface.

In order to minimize impacts to existing buildings in the area, several alternative locations for the proposed underground South Station were considered. Atlantic Avenue represents the western limit and the Fort Point Channel the eastern limit for potential rail link South Station sites. More advanced engineering studies would be required to determine a specific station site.

Central Station. The underground rail link Central Station would be located under the CA/T tunnel, and extend from Broad Street to State Street. It would be approximately 130 feet below the surface, and would provide access to the adjacent Blue Line Aquarium Station at the northern end of the station.

North Station. The rail link North Station could be located under the Central Artery in the area from Causeway Street to New Sudbury Street. The platforms would be approximately 100 feet below the surface. More advanced engineering studies would be required to determine a specific station site.

Operations

Construction of a rail tunnel connecting North and South Stations under the Build Alternative would convert commuter rail operations from a stub-end system to a run-through operation, and would enable intercity (Amtrak) service to extend to the Anderson Regional Transportation Center (RTC) in Woburn. South Station would remain as the base for intercity Acela (Boston to Washington) operations. The majority of the intercity service would remain on the surface. Approximately one-third of the intercity service would continue through the tunnel with a stop at South Station. Intercity Acela trains would not stop at Central or North Stations, but continue through the tunnel and terminate in Woburn. The Portland, Maine "Downeaster" service would continue to be based on the surface at North Station, with the opportunity for a cross-platform transfer to the Acela service in Woburn.

For operational analysis purposes, it was assumed that up to 52 trains a day (26 in each direction) could operate between Boston and New York.[7] Approximately one third of the intercity trains would use the tunnel, stopping only at South Station and terminating in Woburn. It was assumed that there would be no direct intercity service from points south of Boston to north of Woburn. It was also assumed that the intercity trains operating through to Woburn would still be serviced at Amtrak's South Bay maintenance facility. This would require some additional non-revenue miles between Woburn and South Station to properly position equipment. No other impacts on Amtrak intercity operations were identified.

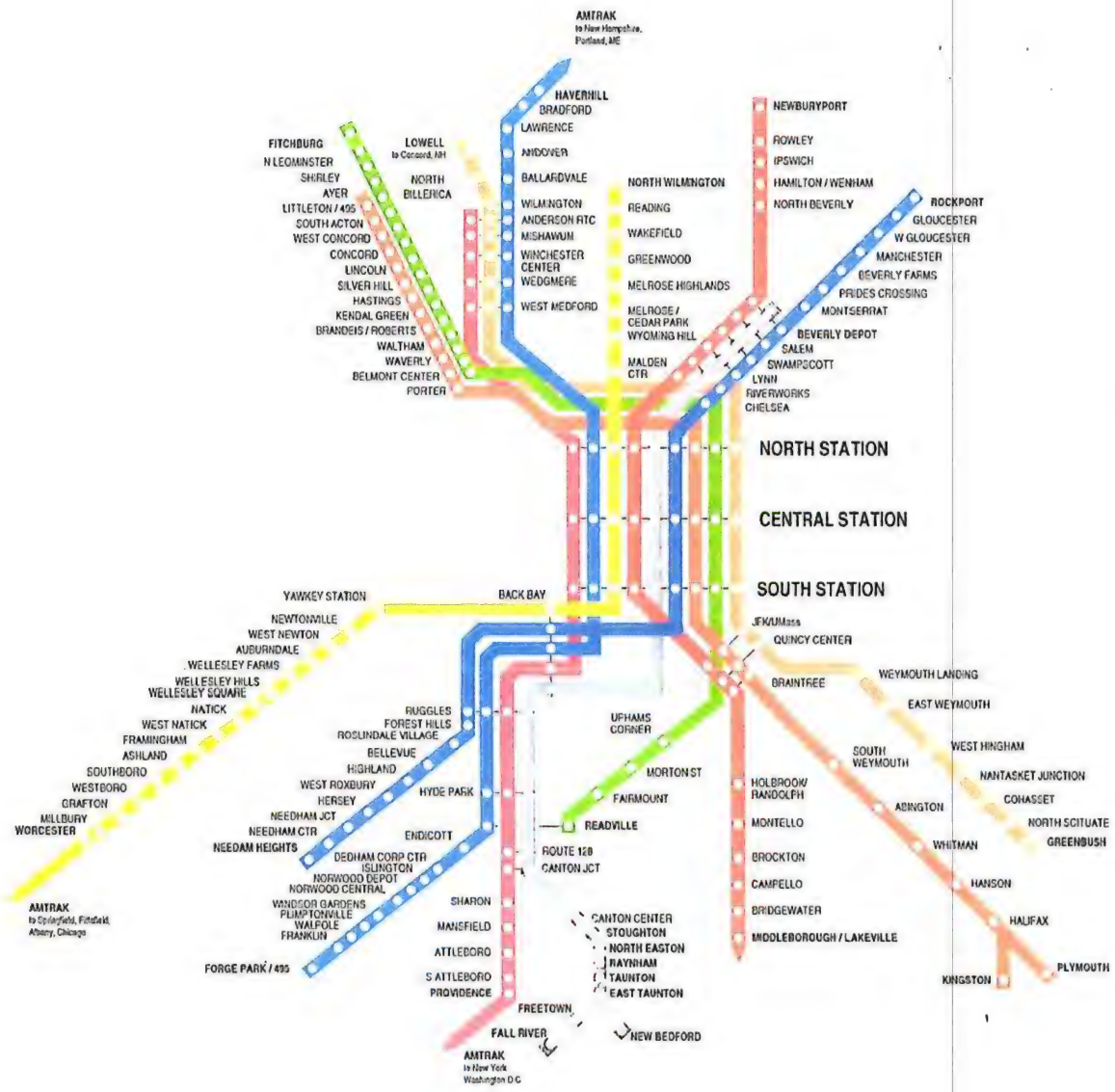
The operational assumptions were developing based on the 2020 commuter rail service schedules developed by the MBTA, and intercity service options developed by Amtrak. The operational analysis assumed that all tracks within the tunnel would be bi-directional and that trains would operate on a desired headway of 5 minutes, with a 4-minute minimum headway. During peak periods, trains would have a frequency of 30 minutes or less, and a frequency of 60 minutes or less during off-peak periods. It was assumed that all terminal tracks at North and South Stations would remain in place and operational to accommodate a portion of existing rail services operated both by Amtrak and the MBTA.

An initial set of line pairings were developed for analytical purposes. These line pairings connect southside commuter rail lines with northside commuter rail lines to create a run-through operation. The pairings vary by alternative and are meant to provide a preliminary analysis of tunnel operations. Figure ES-4 illustrates the Four–Track rail link line pairings.

Summary of Build Alternative Operational Considerations. Construction of a rail tunnel could provide a key component of the future commuter rail system in the Boston region. Both downtown terminals are projected to be at or over effective peak period capacity under 2025 No-Build ridership projections. Introduction of the tunnel connection provides a potential solution to terminal capacity issues and provides significant opportunity to enhance system capacity. The capability to provide run-through service in either a four- or two-track tunnel is expected to:

- Provide a significantly greater level of capacity to accommodate peak period train movements than the existing stub-end terminals at North and South stations.
- Reduce non-revenue ("deadhead") movement of equipment.
- Reduce the number of equipment turns required under congested terminal conditions.

[7] Amtrak's current plans are for 34 trains by 2010; however, 52 were used for planning purposes, which is consistent with Northeast Corridor Improvement Program (NECIP) infrastructure planning.



Source: Central Transportation Planning Staff

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Proposed Rail Link Line Pairs
Four Track Alternative

Figure ES-4

- Achieve maximum ridership growth through efficient use of equipment.
- Provide more direct access to equipment maintenance facilities.

In addition, the operation of a four-track tunnel offers the following advantages over the two-track tunnel:

- Four-Tracks provide a significant increase in overall commuter rail system capability. Combined with continued surface terminal operations, the future commuter rail system with a Four-Track tunnel has greater operational flexibility and the ability to absorb continuing increases in commuter rail ridership.
- Operating patterns (such as zone express, skip-stop express, and tandem express) could be maximized to their fullest advantage.
- Four-Tracks would allow for greater operational flexibility particularly in avoiding intercity trains with longer dwell times, thereby increasing operating efficiencies.

A detailed analysis of commuter and intercity rail operations through the rail tunnel would be required in order to refine the proposed linked north and south side rail operations, should one of the Build Alternative options be selected as the Preferred Alternative.

Equipment

An investigation of tunnel ventilation systems determined that it would not be practical to provide sufficient ventilation along the three-mile tunnel route to allow existing diesel-electric locomotives to operate. An AC traction, dual-mode locomotive capable of running over electrified and non-electrified lines in either the diesel-electric or high voltage (25KV) overhead electrified mode was recommended for rail link operations under a Build Alternative. This locomotive would be compatible with the Northeast Corridor electrification. It would also allow the MBTA to run trains through the tunnel without having to assume the cost of electrifying the entire commuter rail system.

Existing MBTA coaches would be suitable for use in a run-through rail operation. It was assumed that the future Amtrak fleet would be sufficient to handle the service to Woburn, and that no additional Amtrak coaches or locomotives would be required to meet the ridership demands.

Table ES-1 presents a summary of fleet requirements by alternative.

Table ES-1 Fleet Requirements

Fleet Requirements	Existing Fleet (2002)	2025 No-Build/ TSM	Two-Track Build (Back Bay)/ Two-Station	Two-Track Build (Back Bay)/Three -Station	Two-Track Build (South Bay)/Two-Station	Two-Track Build (South Bay)/Three -Station	Four-Track Build /Two-Station	Four-Track Build /Three-Station
Locomotives	80	85	85	85	85	85	85	85
Coaches	377	511	596	622	584	584	655	659

Note: 2025 No-Build Fleet based on the MBTA Capital Improvement Program (CIP) FY2003-FY2007 and anticipated purchases to meet projected demand.

Transportation Impacts and Benefits

Northeast Corridor Intercity Transportation

Total intercity travel by all modes is estimated to increase by 56 percent from 1995 to 2020. Three projects, the electrification of intercity trains between New York and Boston (Acela), the restoration of passenger rail service between Portland and Boston (the Downeaster), and the construction of the Anderson RTC in Woburn that has access to the Portland service, are all expected to contribute to an increase in intercity rail ridership over the next 25 years in the No-Build Alternative.

The three TSM Alternative options would have little, if any, impact on intercity travel since they do not involve any improvements to the intercity transportation network.

The construction of a rail tunnel under the Build Alternative would increase the total number of intercity rail trips in the Northeast Corridor, but would not substantially increase the mode share of intercity rail. (See Table ES-2) Assuming that existing congestion levels remain constant, any of the Build Alternative options would attract about 1,900[8] to 2,300[9] additional trips per day over the No-Build Alternative.

Assuming a 34 train/day schedule between Boston and New York in 2020, the rail link tunnel would be estimated to shift approximately 1,948 daily intercity trips to rail. This represents a reduction in trips by bus of approximately 5.6 percent and a reduction in trips by air of approximately 2.0 percent. The mode shift from automobile, which is the predominant travel mode, is less than 0.2 percent.

[8] Assuming 34 trains per day.
[9] Assuming 52 trains per day.

Table ES-2 Intercity Mode Shares

Mode	1995 Base 20 Trains/ Day		2020 34 Trains/ Day				2020 52 Trains/ Day			
			No-Build		Build		No-Build		Build	
	Trips	%	Trips	%	Trips	%	Trips	%	Trips	%
Auto	369,661	92.14	573,120	91.35	572,253	91.19	571,961	91.12	570,941	90.94
Air	19,451	4.85	27,796	4.43	27,235	4.34	27,117	4.32	26,431	4.21
Rail	6,371	1.59	18,761	2.99	20,709	3.33	21,028	3.35	23,292	3.71
Bus	5,725	1.24	7,780	1.24	7,342	1.17	7,595	1.21	7,157	1.14
Total (Daily)	**401,208**		**627,457**		**627,539**		**627,701**		**627,821**	

No impact would be seen on trips which start and end on either the north or south sides of the rail tunnel. The rail tunnel would not provide additional service to trips that do not traverse the tunnel. Enhanced service such as the high-speed rail on the NEC and the Boston-Portland intercity passenger rail service are the primary reasons for increases in ridership in existing service areas.

The model projects that the construction of the rail tunnel would alter station boarding patterns for intercity rail service in the metropolitan Boston region. This finding suggests that there is a demand for intercity NEC trips coming from the suburbs north of Boston with the better access provided by a suburban station at the Anderson RTC in Woburn.

Boston Metropolitan Regional Transportation

The regional ridership model was geared toward understanding how the proposed NSRL alternatives would affect the Boston metropolitan regional transportation network, particularly on each alternative's ability to add new transit trips to the system. New transit trips are those trips diverted from the automobile to any mode of the transit system. The model assumed that there are no operational constraints and that sufficient train capacity would be provided to handle the projected demand on both the commuter rail and rapid transit systems. The number of new transit trips and the change in daily ridership by mode for each of the alternatives is discussed in the following sections.

The No-Build Alternative identifies a number of potential issues to be addressed by the future MBTA commuter rail and rapid transit systems. The total number of commuter rail passengers entering South Station is projected to increase dramatically, potentially affecting the capacity of South Station to accommodate the number of trains needed to carry passengers.

Under the No-Build Alternative, many commuter rail passengers transfer to rapid transit lines to complete their trip from the suburbs to workplaces in downtown. The Red, Orange and Green Lines are the three transit lines that commuter rail riders currently employ to travel from North or South stations to business centers in the downtown. The peak load points (those

segments of the rapid transit lines that experience the greatest number of passengers) are projected to experience increasing demand, potentially resulting in overcrowding on rapid transit trains and at stations.

The existing levels of congestion on roadways are fairly high and highway congestion is expected to increase by 2025. Increases in roadway traffic congestion alone are anticipated to cause a rise in transit ridership from 6.65 percent to 7.44 percent of total regional trips in 2025.

Transportation System Management Alternatives. The two different TSM Alternative options—a dedicated bus service between North and South Stations and an increased Orange Line service between Back Bay and North Station—are not projected to substantially alter transit mode usage patterns in the regional study area. While these TSM alternatives would improve upon the transit services provided in the No-Build Alternative, each still requires a transfer between travel modes for commuter rail riders wishing to continue their trip through downtown Boston.

The number of new daily transit trips for the TSM alternative in the year 2020 range from approximately 40 for the Downtown Bus Shuttle to 860 for the Surface Artery Shuttle Bus. Increasing the frequency of Orange Line Service between Back Bay and North Stations would add approximately 580 new trips to the transit system. The TSM Alternatives as a whole result in less than a 0.1 percent increase in new system-wide transit trips in comparison to the No-Build Alternative. Therefore, none of the TSM alternatives are that effective in removing vehicle trips from the regional highway system.

The shuttle bus TSM Alternatives are expected to increase local bus trips by about 3.0 percent and to decrease rapid transit trips by about 1.2 to 2.4 percent, since they provide an alternative to the rapid transit system for accessing downtown Boston. Conversely, the Orange Line TSM reduces local bus trips by about 0.2 percent, and increases rapid transit trips by approximately 0.4 percent, since it provides more frequent rapid transit service in downtown Boston. Commuter rail trips would increase by about 0.01 percent to 1.2 percent daily, with the Surface Artery Shuttle bus the most effective in attracting commuter rail trips. The ridership forecasts for the TSM Alternatives are summarized in Table ES-3.

Table ES-3 Daily Regional Mode Share and TSM Alternatives Ridership Forecasts - 2020

	Modeled 1993 Base	2020 No-Build	2020 TSM Alternatives: Downtown Bus Shuttle	2020 TSM Alternatives: Surface Artery Bus Shuttle	2020 TSM Alternatives: Expanded Orange Line Service
Regional					
Systemwide Linked Transit Trips	682,400	879,200	879,200	880,100	879,200-880,100
Transit Mode Share (%)	6.79	7.59	~7.60	~7.60	~ 7.60
New Transit Trips (Diversion From Automobile)			40	860	580
Transit Unlinked Trips					
Commuter Rail	93,390	160,535	161,525	~162,525	~161,000
Rapid Transit	570,500	721,050	703,450	712,750	724,090
Piers Transitway	-	35,050	35,300	35,500	35,050
Local Bus	338,600	443,870	457,860	455,325	443,100
Express Bus	28,000	30,910	29,900	30,720	30,600
Commuter Boat	2,700	3,400	3,360	3,360	3,360
Private Bus	5,650	6,300	6,350	6,350	6,350
TSM Service Ridership	-	-	16,260*	12,225*	22,940 **
Total (unlinked trips/day)	**1,038,840**	**1,401,115**	**1,397,745**	**1,406,530**	**1,403,550**

* Included within Local Bus total.
** Included within Rapid Transit total.
Source: Central Transportation Planning Staff, 1996

Build Alternatives. By allowing service through Boston between the now separate north and south side commuter rail systems, the rail link tunnel proposed by the Build Alternative would eliminate the need for many commuters to transfer to other modes to reach their final downtown Boston destinations. The increase in new system-wide transit trips projected to occur with the Build Alternatives ranges from approximately a 1.5 percent increase for the Two-Track options, to a 4.1 percent increase for the Four-Track, Two-Station option. This increase in transit trips would reduce the daily regional vehicle miles traveled (VMT) between 308,000 and 362,000 for the Two-Track Build Alternatives, and 955,000 to 1,027,000 for the Four-Track Build Alternatives. This translates into a reduction of approximately 47,000 vehicle trips per day for the Four-Track/Three-Station Build Alternative. This would result in a reduction of 300 to 700 vehicles per day on each of the Boston Metropolitan region's radial highways, such as I-93, I-90, Route 24 etc. Over 90 percent of this reduction would occur during the peak periods.

The number of new transit trips added to the system ranges from approximately 19,000 new trips per day for the Two-Track (South Bay Portal), Two-Station option to 54,350 new transit trips per day for the Four-

Track, Three-Station option. Of all the Build Alternatives, the Two-Track, South Bay Portal option is the least attractive since the paired commuter rail lines bypass Back Bay Station, a major downtown commuter rail station. The Four-Track options provide run-through service for the majority of the paired commuter rail lines, and therefore better overall access to the downtown commuter rail stations than the Two-Track options. The Build Alternative would reduce rapid transit trips in the downtown area between about 2.9 percent for the Two-Track, Two-Station (South Bay Portal) option to about 5.2 percent for the Four-Track, Two-Station option. The Build Alternative would also reduce daily trips on local buses by 1.8 to 2.6 percent.

South Station would see a relatively large increase in commuter rail passenger volume (56 to 80 percent) and North Station would see a net decrease in passenger volume (41 to 66 percent). This would be result of the new access from the north to the Financial District and the South Station area, as well as new development in the South Boston Waterfront area that would attract ridership. The ridership analysis indicates that there is more ridership demand from the north side lines to South Station than from the south side lines to North Station.

A rail link tunnel would have the largest impact on the Orange Line, since it is the only line that connects to both the north side (North Station) and the south side (Back Bay Station) commuter rail systems. By reducing passenger volumes at peak load points, future capacity constraints on the Orange Line could be alleviated by the construction of a rail link.

Commuter rail trips are projected to increase under the Build Alternative, by approximately 23,600 (9.6 percent) for the Two-Track (South Bay), Two-Station option to 82,700 (33.8 percent) for the Four-Track, Three-Station option. This increase is larger than the increase in new transit trips, indicating that approximately 20 to 30 percent of the new commuter rail trips represent passengers that would switch to commuter rail from other transit modes. (See Table ES-4 for summary.)

Environmental Consequences

This section provides an overview of the long-term impacts associated with each of the alternatives, as well as the short-term impacts associated with construction of the Orange Line TSM and Build Alternatives. A summary of environmental impacts is provided in Table ES-5.

Table ES-4 Daily Regional Mode Share and Ridership Forecasts – 2025 Build Alternatives

			2025 Build Alternatives					
			Two-Track South Bay Portal		Two-Track Back Bay Portal		Four-Track	
	Modeled 2000 Base Year	2025 No-Build	Two-Station	Three-Station	Two-Station	Three-Station	Two-Station	Three-Station
Regional								
Systemwide Linked Transit Trips	873,000	1,313,200	1,332,200	1,334,700	1,332,700	1,335,200	1,364,000	1,367,550
Transit Mode Share (%)	6.65	7.44	7.54	7.56	7.55	7.56	7.72	7.75
New Transit Trips (Diversion From Automobile)	N/A	N/A	19,000	21,500	19,500	22,000	50,800	54,350
Transit Unlinked Trips								
Commuter Rail	131,650	244,600	268,200	271,700	273,950	284,800	314,500	327,300
Rapid Transit	767,500	1,074,000	1,042,500	1,040,500	1,041,500	1,033,000	1,018,200	1,029,700
Silver Line & AITC	N/A	104,000	91,000	85,500	90,350	84,400	92,000	83,000
Local Bus	380,600	627,150	613,150	611,150	615,650	612,650	615,400	612,000
Express Bus & Commuter Boat	43,000	76,100	67,100	57,200	66,300	66,100	66,300	65,400
Private Bus	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total (unlinked trips/day)	**1,322,750**	**2,125,850**	**2,081,950**	**2,066,050**	**2,087,750**	**2,080,950**	**2,106,400**	**2,117,400**

Source: Central Transportation Planning Staff, 2002

Table ES-5 Summary of Environmental Impacts

Impact Category	TSM Alternatives	Build Alternatives
Land Use	None from bus shuttle. Use of parkland (Southwest Corridor park) for Orange Line TSM	• Land acquisitions to be refined during Preliminary Engineering (PE) • Potential use of 1 plaza (Central Station), 2 landscaped areas (Central and South Stations). Requires additional coordination during PE • Coordination with existing and proposed land uses required in the North and Central Station areas.
Geology, Soils, and Hazardous Waste	None for bus shuttle. Removal of excavate for passing track construction for Orange Line TSM	• Excavate would be generated at sites of all portals, headhouses, and emergency egress shafts. As proposed, it would be transported to a staging area, where it would be stored temporarily before transfer to locations where it could be reused or permanently disposed
Traffic	None	• Short-term increases in vehicular traffic at construction areas. Increased pedestrian traffic at station areas.
Air Quality	None	• Trains would switch to electric power in tunnel corridor, which would improve local air quality over existing conditions with diesel trains. • Regional air quality benefit from reduction in air pollutant emissions due to a reduction in VMT.
Noise and Vibration	None	• Short-term increases in noise and vibration levels related to construction, would occur at portal areas and station areas. Mitigation would reduce impacts. • Reduction in noise levels when compared to the No-build Alternative due to use of electric locomotives in tunnel corridor. • Operational train noise does not meet FTA criteria for severe impact. No mitigation required.[10] • No vibration impacts when evaluated against FTA's ground-borne vibration impact criteria. No mitigation required.
Public Health and Safety	None	• No adverse impacts
Cultural Resources	None	• Potential impacts to cultural resources at station headhouse locations to be further defined during preliminary engineering and mitigation measures developed.
Visual Resources	None	• Additional design development to occur in preliminary engineering to incorporate surface structures into the surrounding urban context.
Water Resources	None	• No long-term impacts. All structures located below mud line of Charles River and Fort Point Channel. Potential short-term impacts to Fort Point Channel during construction of Dorchester Avenue alignment option.
Wildlife and Vegetation	None for bus shuttle. Portion of Southwest Corridor Park vegetation displaced by Orange Line TSM.	• Displacement of small lawn and landscaped areas at South and Central Stations.

[10] Note noise modeling would need to be updated in a Final Environmental Impact Report (FEIR) due to new residential development in North Portals area subsequent to original noise analysis.

TSM Alternatives

Long-Term Impacts

The TSM Bus Alternatives result in a no long-term adverse impacts. Neither the TSM Bus nor the Orange Line Alternatives would have much effect on transportation mode choice, resulting in less than a 0.1 percent increase in new system-wide transit trips. As a result, these alternatives do not result in a reduction of automobile trips. Therefore, the TSM Alternatives would not result in any measurable air quality benefits.

Increasing the frequency of Orange Line service between Back Bay and North Station would require the addition of two passing tracks to allow the trains to reverse direction. Minimal construction would be required between Community College and Wellington Stations on the north side since an existing track and adjacent platform could be used to accommodate the reverse movement of Orange Line trains.

A new track to accommodate the Orange Line shuttle would need to be constructed on the southside between Ruggles and Roxbury Crossing Stations. Construction of this additional 1,400 feet of track would require the widening of the Orange Line boat section by approximately thirteen feet. Approximately one acre of land from the adjacent Southwest Corridor Park would be required, resulting in adverse Section 4(f) [11] impacts to parkland.

Short-Term Impacts

The TSM Alternatives result in no adverse short-term impacts. The operation of additional bus service on downtown Boston streets would not require any construction within the project corridor and would be compatible with the No-Build conditions.

Construction impacts associated with construction for the Orange Line TSM Alternative between Ruggles and Roxbury Crossing Stations include noise and dust impacts from demolition of the existing retaining wall, earth removal, and construction of the new wall and track section. Measures would be employed during construction to mitigate these impacts.

Build Alternatives

Long-Term Impacts

By closing a gap in the existing rail infrastructure, construction of a rail tunnel between North and South Stations under the Build Alternative would create a single regional rail system from the two existing separate

[11] Section 4(f) of the Department of Transportation Act of 1966 (49 USC 303) protects publicly-owned parks, recreation lands, and wildlife refuges. See Section 5.8 of the full MIS/DEIR for additional information.

commuter rail systems, and extend intercity rail service on the Northeast Corridor to the north of Boston. These operational changes would increase transit trips by 1.5 to 4.1 percent and reduce regional vehicle (automobile) miles traveled (VMT) by approximately 308,000 to 362,000 for the Two-Track Build Alternatives, and 1 million miles per day (0.7 percent) for the Four-Track Build Alternative. As a result, the Build Alternative results in a reduction in air pollutant emissions of 370-1,300kg/day for volatile organic compounds (VOC's), 4,900-17,000kg/day for carbon monoxide (CO), and 440-1,500 kg/day for nitrogen oxide (NOx). Switching from the diesel engines currently used to dual-mode engines in the quieter electric mode would reduce noise impact and diesel emissions in the portal and tunnel areas.

The Build Alternative results in relatively few long-term adverse impacts, since the majority of the structures, such as the tunnel and stations, would be underground. The potential for impacts is largely associated with those project elements that interface with the surface such as the portals and headhouses. The portal structures would be located within existing railroad right-of–way and therefore are a compatible use. Due to the complexity of the project and the conceptual nature of the design plans developed for the MIS/DEIR, there is insufficient design detail at this time to fully evaluate potential impacts. Should the Build Alternative be selected as the Locally Preferred Alternative, areas of potential impact associated with the rail link tunnel and station components would require additional investigation.

Short-Term Construction Impacts

The Build Alternative rail link tunnel could be constructed as a deep bore tunnel with a tunnel boring machine (TBM). The total construction period for the Build Alternative would be expected to range from six to eight years depending on the construction technique used for the stations and the availability of construction access. It was assumed that tunnel construction could begin at the North Portals in the Boston Engine Terminal (BET), since this area may provide more opportunities for construction staging sites than the Back Bay or South Bay Portals area. Siting construction staging in an area with rail access would minimize impacts by allowing most of the excavate and construction materials to be transported by rail instead of truck.

Construction techniques may vary among the underground rail link stations. Construction access shafts at the surface would be needed to allow for underpinning of structures, such as the CA/T tunnel, which are located above the proposed stations. The construction access shafts have the potential to create short-term construction impacts. The locations of construction access shafts and staging areas have not been fully defined at this time due to the schematic nature of the current Build Alternative design.

A geotechnical boring program and additional engineering would be required to determine the exact location of each station and associated headhouses,

as well as the recommended construction technique, staging areas, access requirements and amount of excavate to be removed. A more detailed construction approach would need to be developed to fully identify construction impacts and mitigation measures.

Evaluation of Alternatives

A multiple-measures approach to evaluating alternatives was employed for the North-South Rail Link MIS/DEIR study. Each alternative was evaluated on the basis of financial feasibility, effectiveness and equity measures.

Financial Feasibility

The financial feasibility of the NSRL study alternatives was evaluated by comparing the capital and operating cost of each of the alternatives to the availability of funds.

MBTA System Costs and Revenues

The *Boston Region MPO Transportation Plan 2000-2025* summarizes the planned capital, operating, and maintenance costs and the resources available to fund transportation obligations for the next 24 years (2000-2025) and represents the No-Build Alternative.

Table ES-6 summarizes the projected MBTA system costs and revenue for the period of 2000 to 2025. The recent Forward Funding legislation changed the method by which MBTA operating costs and debt service are financed. As of July 1, 2000, the Commonwealth of Massachusetts no longer funds the MBTA in arrears based on the net cost of service. Instead the MBTA now receives a dedicated revenue stream consisting of an assessment on cities and towns within the MBTA district and a dedicated sales tax amounting to one-fifth of the state sales tax revenues. Under the new act the MBTA can no longer issue General Transportation Revenue Bonds backed by the revenues of the Commonwealth. Future bond obligations must now be general obligations of the MBTA or secured by the dedicated revenues provided by the act.

The expected federal and non-federal revenue sources through 2025 total $8,734,000,000. The projected capital need is $8,731,600,000, leaving only $2.4 million to fund capital projects beyond the currently identified needs of the public transportation system between 2000 and 2025. As can be seen, there is no significant surplus available to fund additional capital expenditure beyond that already programmed.

Table ES-6 Projected MBTA System Costs and Revenues

Project Type	Total Cost for Period 2000-2025
Projected Capital Expenditure (2000-2025)	
Reinvestment Needs	$5.50 billion
Expansion Projects	$3.23 billion
Total Projected Capital Spending	$8.73 billion
Projected Capital Funding	$8.73 billion
Projected Operating Costs	$26.25 billion
Projected Operating Assistance	$31.48 billion

Source: *Boston Region MPO Transportation Plan 2000-2025.*

Summary of Capital and Operating Costs for NSRL Alternatives

Table ES-7 summarizes the estimated capital cost for infrastructure and equipment for the NSRL TSM and Build Alternatives under consideration in current (2002) dollars. Infrastructure costs for the Build Alternative include a 50 percent contingency. Capital equipment costs are presented as the incremental cost over the life of the equipment as defined by FTA guidelines. Table ES-8 summarizes the estimated operating costs in current dollars (2002) and in 2014 dollars, which represents the assumed start of operations for financial analysis purposes.

Table ES-7 Summary of Capital Costs (2002 Dollars)*

Alternative	Equipment Cost (1,2)	Infrastructure Cost (3)	Total Capital Cost	Annualized Capital Cost
TSM				
Downtown Shuttle Bus (1)	3,000,000	5,300,000	8,300,000	800,000
Surface Artery Shuttle Bus (1)	3,000,000	9,100,000	12,100,000	1,100,000
Expanded Orange Line Service (2)	126,700,000	53,900,000	180,700,000	15,200,000
Build				
Two-Track (Back Bay)/Two-Station	568,000,000	3,368,700,000	3,936,700,000	320,300,000
Two-Track (Back Bay)/Three-Station	633,300,000	3,911,000,000	4,544,300,000	369,600,000
Two-Track (South Bay)/Two-Station	537,700,000	3,317,100,000	3,854,800,000	313,500,000
Two-Track (South Bay)/Three-Station	537,700,000	9,857,800,000	4,395,600,000	357,100,000
Four-Track/Two-Station	716,400,000	4,921,000,000	5,637,300,000	458,100,000
Four-Track/Three-Station	726,500,000	5,748,000,000	6,474,400,000	525,600,000

Note: * Costs are rounded to the nearest $100,000.
1. Per FTA guidelines, bus procurements are annualized over a 12-year life cycle at a 7 percent cost of capital. Annualization factor = 0.126.
2. Rail procurements are annualized over a 25-year life cycle at a 7 percent rate of capital for the Orange Line TSM and Build Alternative. Annualization factor = 0.086.
3. Infrastructure costs are annualized over a 30-year life at a 7 percent rate of capital. Annualization factor = 0.081.

capital. Annualization factor = 0.081.

Table ES-8 Summary of Estimated Annual Operating Costs *

Alternative	Incremental Annual Operating Costs** (2002 dollars)	Incremental Annual Operating Costs** (2014 dollars)
TSM		
Downtown Shuttle	$900,000	$1,400,000
Surface Artery Shuttle	$800,000	$1,200,000
Expanded Orange Line Service	$9,400,000	$14,200,000
Build* **		
Two-Track (Back Bay)/Two-Station	$6,900,000	$10,400,000
Two-Track (Back Bay)/Three-Station	$6,900,000	$10,400,000
Two-Track (South Bay)/Two-Station	$7,100,000	$10,700,000
Two-Track (South Bay)/Three-Station	$7,100,000	$10,700,000
Four-Track/Two-Station	$8,300,000	$12,500,000
Four-Track/Three-Station	$8,300,000	$12,500,000

* Operating cost estimates were prepared using 1995 cost data for all alternatives except the Expanded Orange Line Service TSM for which 1997 data was provided. The *1997 Transportation Plan for the Boston Region* and *2002 MPO Transportation Plan* do not escalate operating costs during the project life of a system. Therefore, to be consistent with the Plans, after adjusting the costs to reflect FY2014 costs, no escalation has been factored into the annual operating cost estimates.

** As an increment to the No-Build

*** The annual operation cost is the same for both two- and three-station options, and is based on incremental operating costs for the tunnel segment only. The 2002 Estimate is based on actual operations data from 2001 and escalated at a rate of 3.5% per year to 2014.

Cash Flow Analysis

The cash-flow required to support the capital and operating costs of the North-South Rail Link Four-Track/Three-Station Build Alternative was determined in order provide a basis for evaluating various potential funding strategies. The Four-Track/Three-Station Build Alternative presents the most significant cash flow requirements of all the alternatives evaluated.

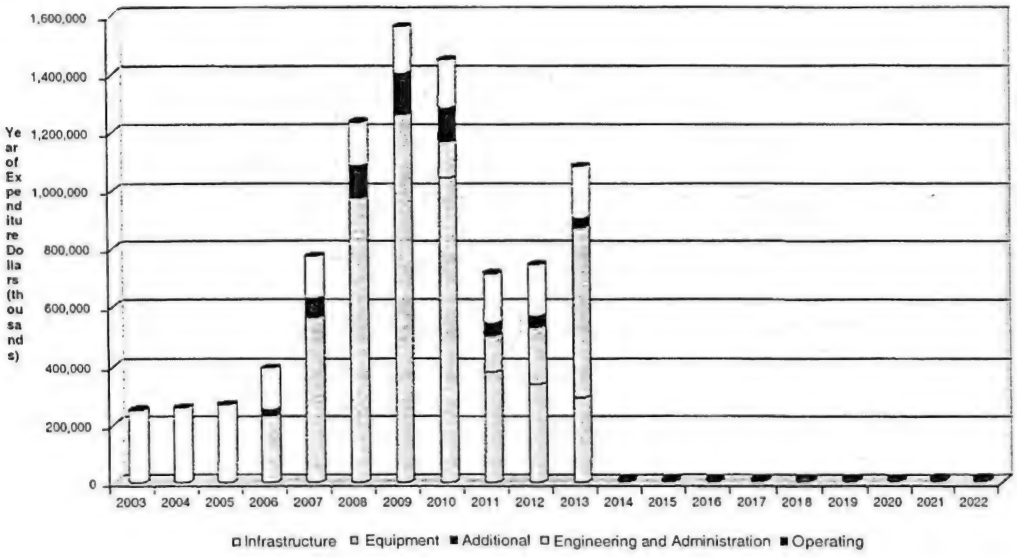
The first step in developing potential funding scenarios is to quantify the amount and timing of the funds required to design, build and operate the alternative. In order to do so, the project's capital and operating costs were estimated and projected on an annual basis using a twenty-year cash-flow model constructed for that purpose. The model assumed that project design begins in 2003.

Due to the uncertainty regarding project sponsorship, the model was constructed on a project finance basis. That is, only cash-flows directly attributed to the project were included in the model. The current model used in this report does not assume any integration of the MBTA's (or any other agency's) financial programs or activities. The project finance approach used to generate the cash-flow estimates is inherently conservative, as it does not allow for any subsidization of project activities from other non-project sources. This allows the project to be evaluated on its

own merits; however, in doing so it does not capture the value of any synergies that may accrue to the system as a whole.

The total annual cash flow required to meet the NSRL's capital and operating costs for the Four-Track, Three-Station Build Alternative are presented in Figure ES-5. As can be seen, annual cash outflows would peak at $1.5 billion in 2009.

Figure ES-5 Total Annual Project Cost



A summary of the total expenditures for the first 20 years of the project in year of expenditure is provided in Table ES-9. These expenditures include $8.7 billion for construction, equipment and associated costs, plus $130 million estimated for operating costs, and reflect the effect of a 3.5 percent inflation rate.

Table ES-9 Summary Use of Funds 2003 – 2022

	Year of Expenditure $ (millions)
Infrastructure	5,085
Equipment	1,030
Additional Project/System	575
Engineering and Administration	2,041
Operating	130
Total	8,861

Clearly, given the multi-billion dollar level of expenditure required, the sponsoring agency is highly unlikely to be able to fund this project on a pay-

as-you-go basis from any single funding source and will need to leverage multiple sources of funding. Obtaining 50 percent FTA grant funding for the NSRL Build Alternative is probably a best-case scenario. Therefore, the annual cash-flow requirements were modeled assuming 50 percent of the construction is funded through federal grants and the remainder through debt financing. Annual funding support needed for the project rises steadily during the period of construction and exceeds $350 million by completion of construction before stabilizing at approximately $360 million per year over the remainder of the 20-year planning period.

Financing Strategies

The NSRL study recognizes that innovative funding strategies would need to be identified as potential funding sources for project development and implementation if the Build Alternative is selected as the Locally Preferred Alternative. In developing these funding alternatives, it is recognized that the size of the project is such that it is unlikely to be successful on its own without some form of statewide or New-England-wide regional support. The ability of the two primary users, MBTA and Amtrak, to pay user charges for rail link services is limited; both entities find their resources stretched to cover existing operations.

The financing strategies presented below incorporate several revenue sources to support the NSRL Build Alternative, but leave a substantial amount to be funded by policymakers as part of the overall implementation scheme. Several forms of additional funding support could provide the necessary to-be-funded amounts, and have been used successfully elsewhere by states or municipalities to support debt financing of large transportation infrastructure projects of this type. These sources include: transit-oriented development (TOD) participation and related revenues; general obligations of the state or municipalities; allocation of existing (or incremental) property, income, corporate, and/or sales taxes; fuel taxes and vehicle registration fees; and revenues derived from governmental assets. Any of these revenue sources could be matched with an appropriate governance mechanism and used to underpin the financial structure for construction of the NSRL Build Alternative.

The following briefly summarizes the three financing strategies that were developed based on the evaluation of key strategic factors, the selected funding sources, and the cash flow requirements.

- **Funding Plan 1 -A Commonwealth Rail Development Organization** that takes responsibility for coordinating the final planning, development, and financial support for the NSRL project. Construction funds would be obtained from FTA capital grants, a combination of Transportation Infrastructure Finance and Innovation Act (TIFIA) and Railroad Rehabilitation and Improvement Financing (RRIF) Federal loans, and other project debt. Funding for initial project activities and project debt service would be provided by revenue from a

charge per each train that used the tunnel and a to-be-funded governmental payment, augmented by joint development and station concession revenues. To ensure financial viability a governmental payment of approximately $124 million annually would be required.

- **Funding Plan 2 - A New England Regional Transportation Authority,** in which a regional multi-state authority coordinates final planning, develops, and supports the NSRL project. Financing is similar to that described above in Funding Plan 1, in that construction funds would be obtained from FTA capital grants, a combination of TIFIA and RRIF Federal loans, a government payment and project debt. However, it is anticipated that the source of the government payment would differ from Funding Plan 1 in order to reflect the multi-state nature of the sponsoring entity.

- **Funding Plan 3 - A Public-Private Development Corporation** in which the Commonwealth awards a concession to a public-private development consortium, organized under a 63-20 non-profit corporation umbrella, that assumes responsibility to complete final planning, development, and financial support for the NSRL project. The project is built on a Design-Build basis by the private consortium, which would obtain construction funds from project debt plus a combination of FTA capital grants and TIFIA and RRIF Federal loans. The consortium accelerates the construction schedule by approximately 25% through a Design-Build procurement. Funding for project debt service would be generated by an annual governmental (Commonwealth and/or multi-state) payment of approximately $179 million, augmented by the train user fee, and revenues from expanded project concessions and joint development opportunities. Once construction is complete, and project-related revenues are accruing, the payment can be reduced or used to support other projects.

Each funding plan has sufficient cash flow to fund construction and operation through a combination of pay-as-you-go and debt financing while also meeting or exceeding debt service coverage targets. Each option has merit, and preference for any single funding plan is more dependent on both political and strategic considerations than on considerations of financial viability and stability.

Effectiveness

Financial considerations are a significant factor in the evaluation of alternatives, particularly in the case of the NSRL Build Alternatives, which would require a large capital investment in order to be implemented. However, it is also important to evaluate the degree to which each alternative accomplishes the purposes that the proposed transportation improvements are intended to address, i.e. the ability of the alternative to meet the project goals and objective. The measures of effectiveness incorporate FTA evaluation criteria, including mobility improvements and

cost-effectiveness. Tables ES-10 and ES-11 provides a summary of the effectiveness of each of the alternatives in supporting the project goals and objectives.

Travel-Time Savings

This measure reflects the aggregate travel time savings associated with the proposed Build Alternatives relative to the No-Build Alternative. This measure is normalized by the annualized capital cost of each alternative, resulting in a measure dollar of capital cost per hour saved. Travel time savings range from approximate 28,000 to 37,900 hours per day for the Two-Track Build Alternatives, and 48,000 to 55,000 hours per day for the Four-Track Build Alternatives. The capital cost per hour saved is approximately $31 to $42 per hour for the Two-Track Build Alternative, and approximately $33 for the Four-Track Build Alternative. Most of the travel time savings would be realized by auto-users that do not switch to transit. The trend in travel-time savings follows the reduction in vehicle miles traveled (VMT) associated with the Build Alternatives. Travel time savings are summarized in Tables ES-10 and ES-11 (See Item 18).

Cost Effectiveness

Cost-effectiveness measures the extent to which each alternative provides a level of benefits in terms of new transit trips that is commensurate with its operating and capital costs. The result of the cost-effectiveness analysis indicates that the cost per new transit rider for the TSM Alternatives ranges from $6.83 for the Surface Artery Shuttle Bus to $140.72 for the Expanded Orange Line Service. The cost-effectiveness index for the Build Alternative options ranges from $28.68 to $56.03, with the Four-Track/Two-Station Build Alternative being the most cost effective of the Build Alternatives. The cost-effectiveness analysis for each of the alternatives is summarized in Tables ES-10 and ES-11 (See Item 14).

Environmental Benefits

Federal Transit Administration Environmental Benefits criteria primarily measures the effects of a project on regional air quality. As can be seen from the summary of reduction in air pollutant emissions presented in Tables ES-10 and 11 (See Item 17), the TSM Alternatives do not result in any reduction in air pollutant emissions. All of the Build Alternatives provide benefits in terms of reduction in air pollutant emissions ranging from 370-1,300kg/day for VOC's, 4,900-17,000kg/day for CO, and 440-1,500 kg/day for NOx. The greatest reduction in air pollutant emissions is associated with the Four-Track/Three-Station Build Alternative.

Table ES-10 Effectiveness Evaluation Summary – TSM Alternatives

Goal/Measures Of Effectiveness		TSM Alternatives (2020) Downtown Bus Shuttle	Surface Artery Bus Shuttle	Expanded Orange Line Service
Goal 1:	**Preserve and Upgrade the Existing Rail System and Reduce Congestion on Existing Services and Facilities**			
1.	New transit trips (daily)	40	860	580
2.	Increase in new transit trips (%)	----------Less than 0.1%----------		
3.	New commuter rail trips (daily)	990	1,940	465
4.	Increase in daily commuter rail trips (%)	0.6%	1.2%	0.3%
5.	New intercity rail ridership (daily)[1]	0	0	0
6.	Increase in daily intercity rail riders	0	0	0
7.	Change in rapid transit trips	-17,600	-8,300	+3,040[2]
8.	Diversions from auto (daily) (includes 867 from intercity rail)	40	860	580
9.	Diversions from air (daily)	0	0	0
10.	Peak hour station rail capacity	-----Demand may exceed capacity-----		
Goal 2:	**Provide Increased Opportunities for Multimodal Connections**			
11.	Daily regional transit mode share	7.60	7.60	7.60
12.	Increase in non-CBD station rail ridership (suburb – suburb trips)	610	610	610
13.	Increase in regional rail/intermodal interfaces	Low	Low	Low
Goal 3:	**Maximize Use of the Existing and Programmed Transportation Infrastructure and Investments**			
14.	Cost per new transit trip (2002 $)	$148.50	$6.83	$140.72
15.	Change in CBD commuter rail station ridership	380	380	380
Goal 4:	**Maximize Environmental and Economic Benefits**			
16.	Reduction in regional vehicle miles traveled daily (VMT)	0	0	0
17.	Change in regional air emissions in kg/day (CTPS model)			
	VOC	0	0	0
	CO	0	0	0
	NOx	0	0	0
18.	Travel Time Savings (hrs/day)	Not estimated	2,629	802

1 Assumes 34 intercity trains per day. Ridership presented for 2020.
2 Includes trips on the Expanded Orange Line Service TSM Alternative also.

Table ES-11 Effectiveness Evaluation Summary – Build Alternatives 2025

Goal/Measures Of Effectiveness		South Bay Two-Track Two-Station	South Bay Two-Track Three-Station	Back Bay Two-Track Two-Station	Back Bay Two-Track Three-Station	Four-Track Two-Station	Four-Track Three-Station
Goal 1:	**Preserve and Upgrade the Existing Rail System and Reduce Congestion on Existing Services and Facilities**						
1.	New transit trips (daily)	19,000	21,500	19,500	22,000	50,800	54,350
2.	Increase in new transit trips (%)	1.4%	1.6%	1.5%	1.7%	3.9%	4.1%
3.	New commuter rail trips (daily)	23,600	27,100	29,350	40,200	69,900	82,700
4.	Increase in daily commuter rail trips (%)	9.6%	11.1%	12.0%	16.4%	20.8%	33.8%
5.	New intercity rail ridership (daily)[1]	1,948	1,948	1,948	1,948	1,948	1,948
6.	Increase in daily intercity rail riders	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%
7.	Change in rapid transit trips	-31,500	-33,500	-32,500	-41,000	-55,800	-44,300
8.	Diversions from auto (daily) (includes 867 from intercity rail)	19,867	22,367	20,367	22,867	51,667	55,217
9.	Diversions from air (daily)	128	128	128	128	128	128
10.	Peak hour station rail capacity	- - - - - - - - Run through service provides sufficient capacity. - - - - - - - - -					
Goal 2:	**Provide Increased Opportunities for Multimodal Connections**						
11.	Daily regional transit mode share	7.54	7.56	7.55	7.56	7.72	7.75
12.	Increase in non-CBD station rail ridership (suburb – suburb trips)	3,150	3,100	3,200	3,000	6,000	5,600
13.	Increase in regional rail/intermodal interfaces	Med	High	Med	High	Med	High
Goal 3:	**Maximize Use of the Existing and Programmed Transportation Infrastructure and Investments**						
14.	Cost per new transit trip (2002 $)	$55.21	$55.43	$54.87	$56.03	$28.68	$30.90
15.	Change in CBD commuter rail station ridership	19,850	23,350	21,950	37,250	63,050	75,550

Table ES-11 Effectiveness Evaluation Summary – Build Alternatives 2025 (Continues)

Goal/Measures Of Effectiveness	South Bay Two-Track Two-Station	South Bay Two-Track Three-Station	Back Bay Two-Track Two-Station	Back Bay Two-Track Three-Station	Four-Track Two-Station	Four-Track Three-Station
Goal 4: Maximize Environmental and Economic Benefits						
16. Reduction in regional vehicle miles traveled daily (VMT)	308,180	350,665	318,045	361,900	955,300	1,026,600
17. Change in regional air emissions in kg/day (CTPS model)						
VOC	-371	-431	-395	-442	-1,198	-1,272
CO	-4,895	-5,694	-5,252	-5,854	-15,971	-16,894
NOx	-438	-500	-461	-523	-1,376	-1,475
18. Travel Time Savings (hrs/day)	28,112	29,287	35,694	37,363	48,267	55,236

1 Assumes 34 intercity trains per day. Ridership presented for 2020.
2 Includes trips on the Expanded Orange Line Service TSM Alternative also.

Equity and Environmental Justice

Equity is the extent to which each alternative provides fair distribution of costs and benefits across various subgroups. The equity evaluation was conducted in compliance with Executive Order (EO) 12898 on Environmental Justice, which requires Federal agencies to insure that adverse impacts of their programs and actions do not disproportionately affect minority and low-income populations.

The TSM and Build Alternatives overall do not result in any notable adverse impacts; therefore, there is no disproportionate adverse impact to minority and low-income populations. Environmental analyses indicate that the Build Alternatives would provide an environmental benefit by reducing air pollutant emissions. The TSM Alternatives do not provide the same benefit since they do not result in a reduction in air pollutant emissions.

Transit system enhancements can provide benefits for urban residents and/or low income and minority populations that may not have access to an automobile, by increasing access to commercial centers, jobs, and recreational areas. Increased access may also enhance economic development opportunities around station areas throughout the system. By connecting the northside and southside commuter rail systems, the Build Alternatives create a more attractive transportation mode and provide greater access throughout the system, thereby improving access to jobs in suburban employment areas via reverse commutes from seventeen rail stations in Boston. The TSM Alternatives would provide more frequent service within the downtown core, but would not provide any new access opportunities to job opportunities beyond downtown Boston.

Next Steps

This document presents an analysis of the project alternatives and provides a framework for informed decision-making on a major transportation investment. It has been distributed to interested parties and governmental agencies for review and comment.

The MIS/DEIR evaluation process is intended to lead to a decision on design concept and scope for major investments and policies that may then be incorporated into the metropolitan area's transportation plan. Submittal of the MIS/DEIR also serves as public notice of the proposed right-of-way (ROW) for the NSRL alignment so that it may be taken into consideration in analyses of future development within the same corridor. If the metropolitan area decides to advance a project that emerges from the process, the next steps would involve project development, including preliminary engineering to define major design features in greater detail, a system-wide operational analysis, completion of the state environmental review process, including preparation of a Final Environmental Impact Report (FEIR), and completion of the National

Environmental Policy Act (NEPA), including Draft and Final Environmental Impact Statements.

Given the multi-billion dollar level of expenditure required for any of the NSRL Build Alternatives, as well as the projected Commonwealth of Massachusetts fiscal year 2004 budget shortfall and the intense competition for federal transit funding on a national basis, it is unrealistic to expect that the NSRL Build Alternative could be developed by either the Massachusetts Bay Transportation Authority (MBTA) or by Amtrak using traditional federal and state transportation funding sources in the foreseeable future. Further advancement of any of the Build Alternatives would require the development of innovative funding strategies and the establishment of a project sponsoring organization with the ability to provide a source of revenue of significant size and stability to support the debt service that would be required to construct the project.

Due to the complexity of the project and the conceptual nature of the Build Alternative design, the full extent of the potential impacts and mitigation measures would also need to be more fully developed by the project sponsor if the project were to be advanced. The issues requiring additional evaluation include:

Operational Issues

- Re-examination of the No-Build conditions, re-assessment of anticipated operational efficiencies and review of anticipated operating costs
- Further review of the impacts on the daily operations of the MBTA commuter rail system including crew and equipment utilization and scheduling, maintenance schedules and locations, and layover locations.

Design/Construction Issues

- More advanced design to allow for definition of structural issues and specific construction methods.
- Identification of a selected construction methodology and staging areas.

Cost/Financing Issues

- Further investigation of additional project costs such as real estate, easements, parking, and system-wide track improvements; and the development of project costs beyond the order-of-magnitude level.
- Establishment of a structure for project sponsorship.

- Development of alternative financing approaches with the ability to provide a substantial source of revenue for the Build Alternative.
- Identification of potential for joint development for station sites.

Coordination with Proposed Developments

- Numerous proposals exist for future development that may directly affect Build Alternative plans. If the Build Alternative is selected, coordination with the proponents of projects within the ROW corridor would be required. Conflicts with other proposed developments could potentially add to project costs.

Environmental Impact Issues

- Update of air quality and noise analyses to reflect land use and other changes since the original analysis.
- More specific location of stations, headhouses and other project components in order to identify any potential impacts related to design and construction.
- Evaluation of methods to accommodate increased pedestrian activity at South Station.
- Development of a more detailed definition of construction impacts and project mitigation.

Permits and Approvals

Construction of the Build Alternative would likely require the following permits and approvals based on the conceptual plans developed to date. Additional design development would be required to more fully define the permits required.

- Preparation of a Section 4(f) evaluation and coordination with the State Historic Preservation Officer (SHPO) if the Build Alternative requires the use of historic properties for station headhouse development or the use of post-Central Artery parklands for construction access and/or emergency egress. Review by the SHPO under Section 106 of the National Historic Preservation Act, and coordination with the Boston Landmarks Commission may also be required.
- An Order of Conditions would be required under the Massachusetts Wetland Protection Act for work associated with South Station and proposed headhouse structures in the vicinity of the Fort Point Channel.

- Water Quality Certification, issued by the Massachusetts Department of Environmental Protection, would be required if the proposed project requires any fill within the Fort Point Channel.
- A Chapter 91 license would be required for the placement of fill or structures associated with the proposed South Station, and emergency egress structures north of the Charles River.
- A Department of the Army Permit under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act if fill and structures are proposed within the Fort Point Channel.
- A Consistency Determination with the Massachusetts Coastal Zone Management Program prior to issuance of Section 10 and Section 404 permits.